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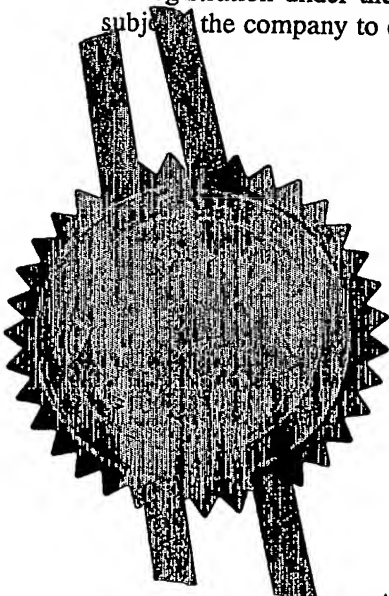
PC

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

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Signed *Al Behan*

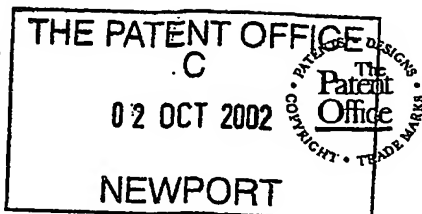
Dated 31 October 2003

An Executive Agency of the Department of Trade and Industry

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Patents Form 1/77

Patents Act 1977  
(16)



02OCT02 0852526-1 C81053  
P01/7700 0.00-0222770.0

### Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road  
Newport  
South Wales  
NP10 8QQ

1. Your reference

EATAIR1

2. Patent application number

(The Patent Office will fill in this part)

02 OCT 2002

0222770.0

3. Full name, address and postcode of the or of each applicant (underline all surnames)

08479081001

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

E. A. TECHNICAL SERVICES Ltd  
7-9 RYDAL PLACE  
CLITHEROE ROAD  
CHATBURN  
LANCASHIRE  
BB7 4JY

4. Title of the invention

AIR CYCLE HEATING AND COOLING

5. Name of your agent (if you have one)

"Address for service" in the United Kingdom  
to which all correspondence should be sent  
(including the postcode)

Patents ADP number (if you know it)

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number  
(if you know it)

Date of filing  
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

- a) any applicant named in part 3 is not an inventor, or
  - b) there is an inventor who is not named as an applicant, or
  - c) any named applicant is a corporate body.
- See note (d))

YES

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9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form

Description 1 /

Claim(s)

Abstract

Drawing(s) 1 ONLY R

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

Request for preliminary examination and search (Patents Form 9/77)

Request for substantive examination (Patents Form 10/77)

Any other documents (please specify)

11.

I/We request the grant of a patent on the basis of this application.

Signature

*Ron Driver*

Date

1 OCT 82

12. Name and daytime telephone number of person to contact in the United Kingdom

RON DRIVER

01200 441492

**Warning**

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

**Notes**

- If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.
- Write your answers in capital letters using black ink or you may type them.
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- If you have answered 'Yes' Patents Form 7/77 will need to be filed.
- Once you have filled in the form you must remember to sign and date it.
- For details of the fee and ways to pay please contact the Patent Office.

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## **AIR CYCLE HEATING AND COOLING**

Cooling in transportation vehicles is traditionally through the use of a vapour compression heat pump with a hydrofluorocarbon as the working fluid. The poor maintenance of such systems has resulted in significant proportions of refrigerant leaking into the atmosphere.

There is a desire to use air as the working fluid but the cycle efficiency is generally not high enough and more energy is expended on running the air fluid system than the conventional system. The balance of pollutant emissions from energy production and refrigerant leakage is determined by the coefficient of performance of the heat pump used to provide the cooling requirement.

In the present invention it is proposed to use a rolling piston compressor and expander of the type described in PCT/GB01/03089 and 0200991.8 and 0211603.6 and 0216084.4 and GB2364552 and use air as the working fluid.

One machine acting as a compressor provided the compression and another one acting as a turbine provides the expansion.

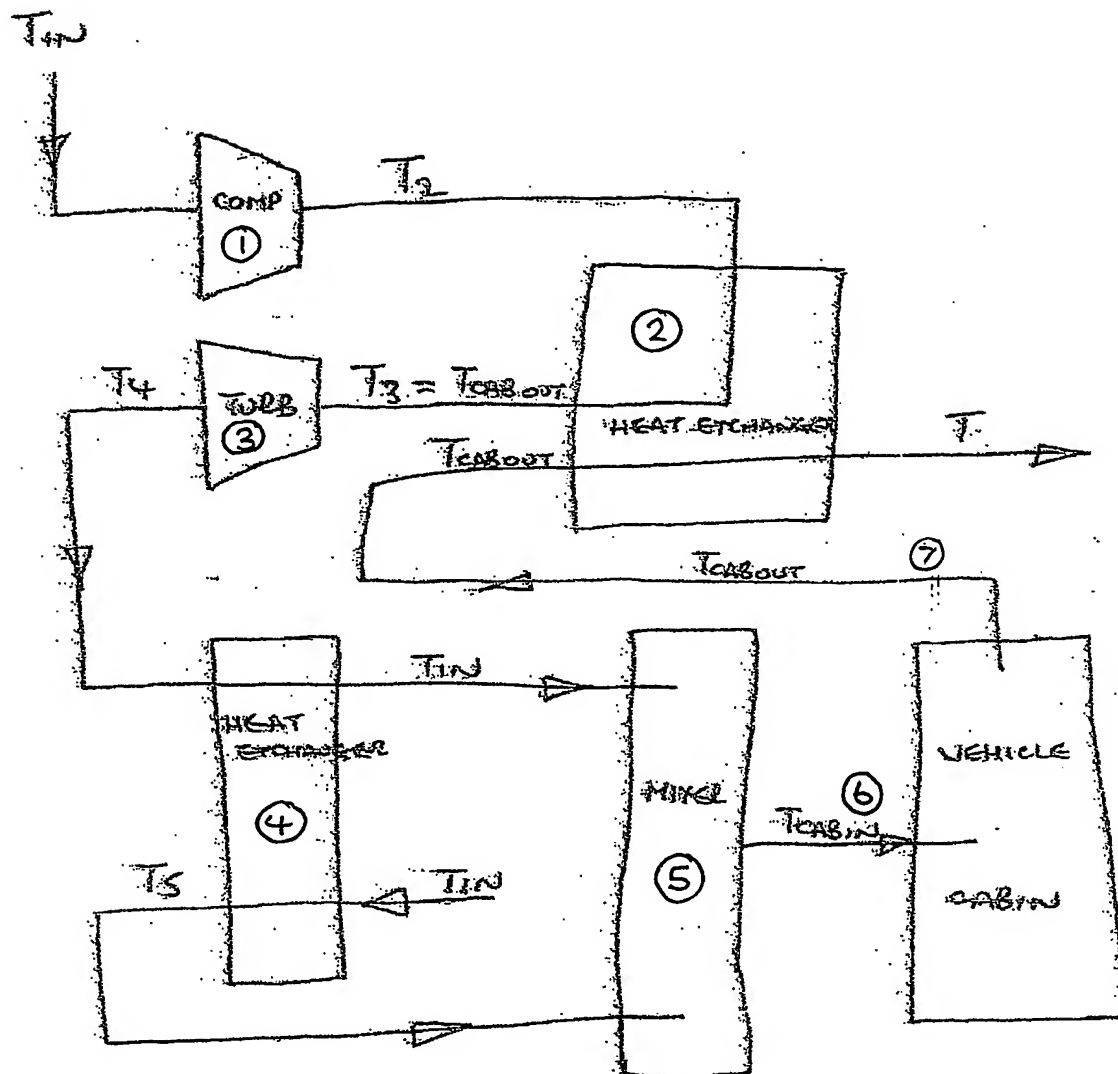
### **Cycle description for cooling**

- (1) Ambient air is compressed.
- (2) Compressed air is cooled by air extracted from the vehicle cabin in a first contra-flow heat exchanger.
- (3) The cooled compressed air is expanded in the turbine.
- (4) The expanded air is passed to a second contra-flow heat exchanger to cool ambient air.
- (5) The cooled ambient air and heated expanded air are mixed.
- (6) The mixed air is passed to the vehicle cabin.
- (7) Air is extracted from the vehicle cabin to pass to the first contra-flow heat exchanger before exiting to atmosphere.

### **Cycle description for heating**

Until the engine cooling water is hot enough, the vehicle cabin air is re-circulated through the first contra-flow heat exchanger or fresh ambient air is used.

A cycle of operation as described above is likely to provide a coefficient of performance sufficient to be competitive with conventional vapour compression cooling systems.



SYSTEM LAYOUT FOR AIR CYCLE